

# PATENT SPECIFICATION

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DRAWINGS ATTACHED.

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## COMPLETE SPECIFICATION.

### Improvements in or relating to Pipe Couplings.

We, K.A.C. LIMITED, a British Company, of Fifth Street, Montrose Avenue, Hillington, Glasgow, S.W.2, Scotland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns improvements in or relating to pipe couplings and, whilst it is primarily concerned with couplings for connecting pipes together end to end, it may be used for securing a blanking-off cap on the end of a pipe; for connecting a pipe to a draw-off cock, or to any other fitting but subsequently all these further fittings will be regarded as, and referred to as, "pipes" unless otherwise specifically stated.

The invention is particularly concerned with couplings for use in conjunction with pipes of relatively small diameter (such as under two inches) and of relatively light gauge material and particularly of metals such as copper, aluminium or the like: such pipes are used especially in aircraft engine installations and often call for pipe couplings capable of withstanding high pressures and it is an object of this invention to provide a simple and improved form of coupling which will afford a leak-tight joint with the pipe or pipes with which it is used.

According to this invention there is provided a pipe coupling which comprises a tubular body having an internal converging frusto-conical bore adapted to receive co-axially the end portion of a pipe, the said bore being so dimensioned with relation to said pipe as to provide around the latter an annular convergent space, a sealing ring of

a soft and substantially ductile material adapted to be located wholly or substantially wholly within the said annular space and having a bulbous ring-like rim part from which extends an integral and continuous annular externally frusto-conical shaped flange which has at the end remote from said bulbous rim part an inturned edge adapted to contact the said pipe, and a union member adapted to encircle the pipe end and so associated with the said body as to be capable of being drawn towards the latter to force the said sealing ring into said annular space, the frusto-conical shaped flange of the said sealing ring having an external surface bearing directly or indirectly against the frusto-conical internal surface of the bore of the said body to cause the bulbous ring-like rim part and inturned flange edge of the sealing ring to bear circumferentially on the external surface of the pipe and to be contracted tightly on to the latter as the ring is forced into said convergent annular space.

According to a further feature of this invention, the said external surface of the frusto-conical flange of the sealing ring may bear against the frusto-conical internal surface of the bore of the said body through the medium of a collet which closely surrounds the sealing ring and has an external surface seating against the internal surface of the bore of the body.

Preferably one end portion of the said collet extends beyond the said sealing ring and has a part spaced from the latter and embracing the pipe. Advantageously the said end portion of the collet is of axially split form so as to tighten onto the pipe when the sealing ring is forced into the said annular space.

According to a still further feature of the

invention, the said sealing ring may be formed of aluminium.

The sealing ring may be formed in any suitable way and may be formed as a casting or as a pressing, the ring-like rim being hollow or solid as desired.

Thus, in one form, the said sealing ring may be formed from a piece of cylindrical tubing which is first spun out to frusto-conical form and then has the marginal portion at the end of larger diameter curled inwardly over on itself to form the said bulbous ring-like rim, the marginal portion at the end of smaller diameter being conveniently turned inwardly so as to form at such end the intumed flange edge substantially perpendicular to the axis of the sealing ring.

In another form, the sealing ring may be cast with the bulbous ring-like rim of solid form.

It will be appreciated that these two forms are similar except that, in the first form, the ring-like rim is hollow, whilst, in the second form, the ring-like rim is solid. In the case where the said rim is hollow, a greater flattening of such rim will occur when the sealing ring is forced into said convergent annular space and the area of contact between the rim and the external surface of the pipe will be greater and a consequently tighter seal will be achieved.

Preferably a pressure ring is provided within the coupling between the said union member and the adjacent end of the sealing ring to transfer pressure from the union member to the ring and preferably the inner end surface of the pressure ring which engages the sealing ring is so inclined to the axis of the coupling as to exert, when pressed against the adjacent end of the sealing ring, an inward and contracting thrust upon the latter.

In one form of coupling according to this invention, the said body may have means for engagement with the end of a pipe or with the ends of adjacent end-to-end pipes so as to prevent axial movement of the body relatively to the pipe as the sealing ring is being forced into the said annular convergent space and said union member may be in the form of a nut adapted to be placed loosely around the pipe and to screw externally onto the said body, the arrangement being such that, as the union nut is screwed onto the body, the said sealing ring is forced coaxially into the frusto-conical bore of the latter.

In a second form of coupling according to this invention and in which a pressure ring is provided, the latter may have means for engagement with the end of a pipe or with the ends of adjacent end-to-end pipes so as not to be axially movable relatively to such pipe or pipes and the said union member

may be adapted to be assembled in the coupling so as to bear against the side of said pressure ring remote from said body and may have a part adapted to be threadedly engaged with the body so as to be capable of being screwed thereon to draw the same towards the said pressure ring to force the sealing ring coaxially into said frusto-conical bore.

Where the coupling is to be used to couple two pipes end-to-end, the said union member may have an internal convergent frusto-conical bore of a form similar to that in the said body and bear on the said pressure ring through the medium of a second sealing ring (and collet if desired) similar to the sealing ring within the said body, one sealing ring bearing on one pipe end and the other sealing ring bearing on the other pipe end.

In order that the invention may be readily understood and that further features of same may easily be appreciated, reference will now be made to the accompanying drawing, in which:—

Figure 1 is a longitudinal section through one embodiment of a pipe coupling according to this invention and for coupling two pipes coaxially together;

Figure 2 is a diametrical section through one of the sealing rings of the pipe coupling of Figure 1;

Figure 3 shows part of Figure 1 on an enlarged scale and illustrates the deformation of a pipe on which the coupling is used;

Figure 4 is a diametrical section through a modification of the sealing ring of Figure 2;

Figure 5 is a longitudinal section through a second embodiment of pipe coupling according to this invention and for coupling two pipes coaxially together; and

Figure 6 is an exploded perspective view, with parts cut away, of the coupling of Figure 5.

Referring to the embodiment of Figures 1, 2 and 3, the coupling, indicated by the reference 1, is shown connecting two straight pipes 2 and 3 of identical external diameter together in end to end coaxial relationship. It should be understood, however, that the same construction can, with slight modifications, be applied to other forms of coupling such as elbow form couplings for connecting pipes together in any appropriate angular relationship, blanking off units for closing the end of a pipe, and so on.

As shown, the coupling 1 comprises a tubular body 4 which is externally cylindrical, and has a central circumferential channel 5 up to which both ends of the tubular body 4 are externally screw threaded as indicated at 6 and 7, so that the body 4 may receive on its ends internally correspondingly screw threaded union nuts 8 and

9 furnished at their outer ends with inwardly directed flanges 10 and 11 respectively perpendicular to the axis of the coupling and having respective central holes 12 and 13, each adapted closely to receive the appropriate pipe 2 or 3 upon which the corresponding end of the coupling body 4 is to be fitted.

Internally the tubular body 4 is provided centrally of its length with an annular inwardly directed flange 14 adapted to form a shoulder or stop against which the ends of the pipes 2 and 3 inserted into the body 4 from opposite ends thereof may firmly engage, the internal diameter of the flange 14 being preferably, as shown, the same as the internal diameter of the pipes 2 and 3.

The bore of the body 4 is enlarged on each side of the central internal flange 14 to form enlargements, each of inwardly convergent frusto-conical form, so as to define around the pipes 2 or 3 upon which the coupling is used inwardly convergent annular spaces 15 and 16 for receiving sealing rings 17 and 18 respectively.

The sealing rings 17 and 18 are formed of a soft metal such as, for example, aluminium, and each comprises as best seen in Figure 2, an outer end portion 19 in the form of a circular ring-like rim of substantially circular radial cross-section, this rim portion being of an internal diameter such as initially to be a close, but free sliding, fit onto the exterior of the pipe 2 or 3 on which it is to be used, and of an external diameter such as to bear against the appropriate frusto-conical internal surface of the bore of the body 4 near the entrance to the corresponding annular convergent space 15 or 16 around the pipe, the entrance to the said space being, of course, at the position at which the frusto-conical surface defining the space is of greater diameter.

The rim portion 19 of each sealing ring is furnished with an annular externally frusto-conical shaped flange 20 which extends tangentially from the outer surface of the rim 19 and converges inwardly from the entrance of the appropriate annular frusto-conical space 15 or 16 towards the narrower end thereof, the flange 20 bearing circumferentially-externally against the internal frusto-conical surface of the body 4 of the coupling. The flange 20 has its annular edge 21 remote from the rim 19 intumed towards the axis of the coupling so as to bear upon the external surface of the appropriate pipe 2 or 3, this inwardly directed annular edge 21 being spaced from the rim 19 and the portion of the sealing ring between this intumed edge 21 of the flange 20 and the rim 19 being well spaced from the surface of the pipe when first applied to the latter.

It will be seen that any radial section of

each of the sealing rings 17 or 18 will be substantially of chemical laboratory retort shape, the outlet stem of the retort having a slightly intumed end portion.

The frusto-conical flange 20 on each sealing ring has such a length in the direction of the axis of the coupling as to provide the sealing ring with a very firm seating against the internal frusto-conical surface of the body of the coupling, but its length is still such as to leave ample room for the sealing ring to be moved bodily endwise into said annular space when the union nut 8 or 9 is screwed tightly onto the body 4 of the coupling.

Between the ring-like rim 19 of each sealing ring and the inwardly directed end flange 10 or 11 of the corresponding union nut, is arranged a pressure ring 22 which is a free fit upon the appropriate pipe and which has an outer end surface 23 at right-angles to the axis of the coupling so as to bear firmly against the inner surface of the inwardly directed flange of the appropriate union nut and has an inner end which has an inner surface 24 of wide angled conical form which converges inwardly towards its outer end. Preferably this conical inner surface 24 of each pressure ring 23 is at right-angles in any radial section to the frusto-conical internal surface of the body of the coupling: thus, if the latter surface is at  $15^\circ$  to the axis of the coupling, as it preferably will be, then the inner surface of the pressure ring will make an angle of  $15^\circ$  with the outer surface of this ring.

It will be appreciated that the coupling 1 is assembled by first threading the union nuts 8 and 9 onto the ends of the pipe 2 and 3 to be coupled together, then placing a pressure ring 22 onto each pipe inside the union nut threaded thereon with the plane surface 23 of such ring in engagement with the corresponding internal surface of the end flange of the union nut; by then placing the sealing rings 17 and 18 on the ends of the pipes 2 and 3 respectively with the ring-like rim portion 19 of each sealing ring in engagement with the conical inner end surface 24 of the pressure ring 22 and by then fitting the ends of the pipes 2 and 3 into the body 4 of the coupling so that they abut the internal central annular flange 14 of the body 4, one each side thereof and the sealing rings are located within the annular spaces within the body; and by finally screwing each union nut onto the adjacent end of the body of the coupling so as to cause each pressure ring to bear upon the adjacent surface of the ring-like rim of the adjacent sealing ring and to urge the latter axially inwardly along the appropriate convergent annular space 15 or 16 defined by the external surface of the pipe and the internal frusto-conical surface of the bore of the body of the coupling, thereby compressing the sealing rings about

the pipe. Continued screwing of the union nuts onto the body of the coupling then causes the pressure ring and the frusto-conical surface of the said body to cause the ring-like rim of the sealing ring to be urged further inwardly and slightly inwardly and annularly, as shown clearly in Figure 3, causing a slight annular indentation in the pipe wall as indicated at 25.

It will be appreciated that, in using this invention in a pipe end fitting for blanking off a pipe, the body of the coupling above described will be replaced by a member representing approximately one half of this body which is closed at its outer end so as to blank off the pipe to which the assembly is attached, appropriate means, e.g. flats, being provided on the union nut and the body of the coupling to hold the body against rotation with respect to the pipe, whilst the union nut is being tightened up, or unscrewed.

Figure 4 shows a sealing ring 26 which is a modification of the sealing ring of Figure 2. The sealing ring 26 is formed from a piece of cylindrical tubing which is first spun out to frusto-conical form and then has the marginal portion at the end of larger diameter curled inwardly over on itself to form a ring-like rim 27, similar to the ring-like ring 19 of the sealing ring of Figure 2, but hollow instead of being solid, and the marginal portion at the end of smaller diameter turned inwardly substantially perpendicularly to the axis of the sealing ring so as to form, at such end, an inwardly directed part 28 similar to the inturned edge 21 of the sealing ring of Figure 2.

As compared with the use of a sealing ring of the form shown in Figure 2, when the sealing ring 26 is used in a coupling according to this invention, a greater flattening of the ring-like rim 27 will occur when the sealing ring is forced into the convergent annular space around the pipe, and the area of contact between the said rim and the external surface of the pipe will be greater and a consequently tighter seal will be achieved.

Figures 5 and 6 illustrate a second embodiment of coupling according to this invention, the coupling being shown in Figure 5 connecting two straight pipes 29 and 30 of identical external diameter together in end-to-end coaxial relationship.

As shown, the coupling comprises a tubular body 31 which is externally cylindrical and has an internal inwardly convergent frusto-conical bore 32, the smaller diameter end of which is of a greater diameter than the external diameter of the pipes 29 and 30 so as to be capable of being slid onto one of the pipes, e.g. on pipe 29 as shown, and to define around the latter an inwardly convergent annular space. At

one end, the body 31 is externally screw threaded as indicated at 33 for co-operation with the internal screw thread 34 of an axial tubular sleeve extension 35 of an externally cylindrical union member 36 which has an internal inwardly convergent frusto-conical bore 37 identical with the bore 32 of the body 31.

The coupling further comprises two sealing rings 38 of the form illustrated in Figure 2, an externally cylindrical pressure ring 39 having a bore therethrough which is equal in diameter to the bore of the pipes 29 and 30, but which is enlarged at its ends to a diameter equal to the external diameter of the pipes so as to leave an annular rib 40 within the pressure ring, and two identical collets 41 each having an external surface 42 of a frusto-conical form and of dimensions such as to be capable of seating within the bores 32 and 37 of the body 31 and union member 36 and an internal bore which has, at the smaller diameter end of the collet, a cylindrical part 43 substantially equal in diameter to the external diameter of the pipes 29 and 30 and, at the larger diameter end of the collet, a frusto-conical part 44 corresponding to the frusto-conical external surface of each of the sealing rings 38. Each of the collets 41 is advantageously axially split at its smaller diameter end as shown and internally hollowed out between the parts 43 and 44 of its internal bore in order to reduce the thickness of the collet at such position to increase the ability of the smaller diameter end of the collet to be contracted.

It will be appreciated that the coupling of Figures 5 and 6 is assembled by first threading the body 31 onto the end of pipe 29 and the union member 36 onto the end of pipe 30; by then inserting the collets 41 into the bores 32 and 37 of the body 31 and union member 36; by next inserting the sealing rings 38 into the frusto-conical parts 44 of the bores of the collets 41; by inserting the ends of pipes 29 and 30 from opposite directions into the enlarged ends of the bore of the pressure ring 39 until such pipes engage against the rib 40; and finally by moving the body 31 and union member 36, together with the collets and sealing rings therewithin, towards the pressure ring 39 and screwing the body 31 and union member 36 tightly together. As the body 31 and union member 36 are screwed together, the engagement of the sealing rings 38 against the pressure ring 39 causes such sealing rings to be forced into the collets 41 and the latter to be forced into the collets 41 and the latter to be forced into the bores 32 and 37 in the body 31 and union member 36 respectively so that the collets grip the pipes and the sealing rings are urged circumferentially onto the pipes in a similar

way to the sealing rings 17 and 18 of the embodiment of Figures 1 to 3.

Preferably, the end faces of the pressure ring 39 are, like the inner surfaces 24 of the pressure rings 22 of the coupling of Figures 1, 2 and 3, of wide angled conical form so that the pressure ring 39 tends to urge the rims of the sealing rings radially inwardly of the pipes.

An important feature possessed by couplings according to this invention and hereinbefore described is that each sealing ring does not bite along a circumferential line into the pipe to which it is fitted but bears upon the latter over a substantial annular area so that razor edge stresses are not set up which is, of course, a tremendous advantage in aircraft engine installations or indeed in any installation where continual high frequency vibration is experienced.

#### WHAT WE CLAIM IS:—

1. A pipe coupling which comprises a tubular body having an internal convergent frusto-conical bore adapted to receive coaxially the end portion of a pipe, the said bore being so dimensioned with relation to said pipe as to provide around the latter an annular convergent space, a sealing ring of a soft and substantially ductile material adapted to be located wholly or substantially wholly within the said annular space and having a bulbous ring-like rim part from which extends an integral and continuous annular externally frusto-conical shaped flange which has at the end remote from said bulbous rim part an intumed edge adapted to contact the said pipe, and a union member adapted to encircle the pipe end and so associated with the said body as to be capable of being drawn towards the latter to force the said sealing ring into said annular space, the frusto-conical shaped flange of the said sealing ring having an external surface bearing directly or indirectly against the frusto-conical internal surface of the bore of the said body to cause the bulbous ring-like rim part and intumed flange edge of the sealing ring to bear circumferentially on the external surface of the pipe and to be contracted tightly onto the latter as the ring is forced into said convergent annular space.

2. A pipe coupling according to Claim 1, wherein the said external surface of the frusto-conical flange of the sealing ring bears against the frusto-conical internal surface of the bore of the said body through the medium of a collet which closely surrounds the sealing ring and has an external surface seating against the internal surface of the bore of the body.

3. A pipe coupling according to Claim 2, wherein one end portion of the said collet extends beyond the said sealing ring

and has a part spaced from the latter and embracing the pipe.

4. A pipe coupling according to Claim 3, wherein the said end portion of the collet is of axially split form so as to tighten onto the pipe when the sealing ring is forced into the said annular space.

5. A pipe coupling according to any of the preceding claims, wherein the said sealing ring is formed of aluminium.

6. A pipe coupling according to any of the preceding claims, wherein the said sealing ring is formed from a piece of cylindrical tubing spun out to frusto-conical form and having the marginal portion at the end of larger diameter curled inwardly over on itself to form the said bulbous ring-like rim and the marginal portion at the end of smaller diameter turned inwardly.

7. A pipe coupling according to any of Claims 1 to 5, wherein the said sealing ring is a casting.

8. A pipe coupling according to any of the preceding claims, wherein a pressure ring is provided within the coupling between the said union member and the adjacent end of the sealing ring to transfer pressure from the union member to the ring.

9. A pipe coupling according to Claim 8, wherein the surface of the pressure ring which engages the sealing ring is so inclined to the axis of the coupling as to exert, when pressed against the adjacent end of the sealing ring, an inward and contracting thrust upon the latter.

10. A pipe coupling according to Claim 8 or 9, wherein the said pressure ring has means for engagement with the end of a pipe or with the ends of adjacent end-to-end pipes so as not to be axially movable relatively to such pipe or pipes and the said union member is adapted to be assembled in the coupling so as to bear against the side of the said pressure ring remote from the said body and has a part adapted to be threadedly engaged with the body so as to be capable of being screwed thereon to draw the same towards the said pressure ring to force the sealing ring coaxially into said frusto-conical bore.

11. A pipe coupling according to Claim 10 and intended to be used to couple two pipes end-to-end, wherein the said union member has an internal convergent frusto-conical bore of a form similar to that in the said body and bears on the said pressure ring through the medium of a second sealing ring.

12. A pipe coupling according to any of Claims 1 to 9, wherein the said body has means for engagement with the end of a pipe or with the ends of adjacent end-to-end pipes so as to prevent axial movement of the body relatively to the pipe as the sealing ring is being forced into the said annular

- convergent space and said union member is in the form of a nut adapted to be placed loosely around the pipe and to screw externally onto the said body. 15
- 5 13. A pipe coupling substantially as hereinbefore described with reference to and as shown by Figures 1, 2 and 3.
14. A pipe coupling according to Claim 13 modified substantially as hereinbefore described with reference to and as shown by Figure 4 of the accompanying drawings.
- 10 15. A pipe coupling substantially as

hereinbefore described with reference to and as shown by Figures 5 and 6 of the accompanying drawings.

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# PROVISIONAL SPECIFICATION.

No. 1605, A.D. 1956

## Improvements in or relating to Pipe Couplings.

We, K.A.C. LIMITED, a British Company, of Fifth Street, Montrose Avenue, Hillington, Glasgow, S.W.2, Scotland, do hereby declare this invention to be described in the following statement:—

20 This invention concerns improvements in or relating to pipe couplings and, whilst it is primarily concerned with couplings for connecting pipes together end to end, it may be used for securing a closure or blanking-off cap on the end of a pipe; for connecting a pipe to a draw-off cock, or to any other fitting but subsequently all these further fittings will be regarded as, and referred to as, "pipes" unless otherwise specifically stated.

25 The invention is particularly concerned with couplings for use in conjunction with pipes of relatively small diameter (such as under two inches) and of relatively light gauge material and particularly of metals such as copper, aluminium or the like: such pipes are used especially in aircraft engine installations and often call for pipe couplings capable of withstanding pressures of up to 40 2,000 to 3,000 pounds per square inch, and it is an object of this invention to provide a simple and improved form of coupling which will afford a leak-tight joint with the pipe or pipes with which it is used.

45 According to this invention there is provided a pipe coupling which comprises a tubular body having an internal conical inwardly converging frusto-conical bore adapted to receive coaxially the end portion of a pipe, the said bore being so dimensioned with relation to said pipe as to provide around the latter an annular inwardly convergent annular space; a sealing ring adapted 50 to be located in said annular space and to be forced inwardly thereinto by a union member surrounding the pipe end and so associated with the said body as to be capable of being drawn towards the latter to force the said sealing ring into said space, and said sealing ring having an external

(preferably frusto-conical) surface adapted to seat against the frusto-conical internal surface of the bore of the said body and also having an internal ring-like rim adapted to bear circumferentially on the external surface of the pipe and to be contracted tightly onto the latter as the ring is pressed into said convergent annular space. 65

According to a further feature of the invention the sealing ring is of approximately retort (chemical laboratory retort) shape in radial cross-section at any point in its circumference, this said cross-section thus having a relatively large circular end portion from the outer portion of which a stem part extends substantially tangentially and then turns slightly inwardly at its other extremity. 70 75

According to a further feature of the invention the said sealing ring is made of a soft and ductile or substantially ductile metal, such as, for example, aluminium, so that it can be deformed inwardly by the inward pressure exerted thereon as it is pressed into the said convergent annular space around the pipe. 80 85

Said body may have means for engagement with the end of a pipe or with the ends of adjacent end-to-end pipes so as to prevent axial movement of the body relatively to the pipe as the sealing ring is being forced into the said annular convergent space and said union member may be in the form of a nut adapted to be placed loosely around the pipe and to screw externally onto the said body, the arrangement being such that as the union nut is screwed onto the body the said sealing ring is forced coaxially into the frusto-conical bore of the latter. 90 95 100

Preferably a pressure or packing ring is provided within the coupling between the said union member and the adjacent end of the sealing ring to transfer pressure from the union member to the ring and preferably the inner end surface of the pressure ring 105

which engages the sealing ring is so inclined to the axis of the coupling as to exert, when pressed against the adjacent end of the sealing ring, an inward and contracting thrust upon the latter.

Thus the invention also resides in a method of applying an end fitting or coupling to a pipe in a fluid-tight manner which comprises arranging around the pipe an inexpandible convergent annular surface and driving between said surface and the pipe an internally annularly rimmed sealing ring in such a way as to contract the said sealing ring about the pipe and to cause the said rim to seat firmly on and even circumferentially to deform the pipe inwardly to receive such rim.

In order that the invention may be readily understood and that further features of same may easily be appreciated, one embodiment of the invention will now be described by way of example.

In the embodiment to be described the coupling is designed for connecting two straight pipes of identical external diameter together in end to end coaxial relationship, but it should be understood that the same construction can, with slight modifications, be applied to other forms of coupling such as elbow form couplings for connecting pipes together in any appropriate angular relationship, blanking off units for closing the end of a pipe, and so on.

The coupling now to be described comprises a tubular body which is externally cylindrical and has a central circumferential groove or channel up to which both ends of the tubular body is externally screw threaded so that the body may receive on each end thereof an internally correspondingly screw threaded union nut furnished at its outer end with an inwardly directed flange perpendicular to the axis of the coupling and having a central hole closely to receive the pipe upon which the corresponding end of the coupling body is to be fitted.

Internally the tubular body of the coupling is provided centrally of its length with an annular inwardly directed flange adapted to form a shoulder or stop against which the ends of a pair of pipes inserted into the body of the coupling from opposite ends thereof may firmly engage, the internal diameter of the said flange being preferably the same as the internal diameter of the pipes.

The bore of the body of the coupling is enlarged on each side of the said central internal flange of the body and this enlargement is of inwardly convergent frusto-conical form in both cases so as to define around the pipes upon which the body of the coupling is used inwardly convergent annular spaces for receiving sealing rings, there being one sealing ring in each of said annular spaces.

The said sealing rings are formed of a soft metal such as, for example, aluminium, and each comprises an outer end portion in the form of a circular ring-like rim of substantially circular radial cross-section, this rim portion being of an internal diameter such as initially to be a close but free sliding fit on to the exterior of the pipe on which it is to be used, and of an external diameter such as to bear against the frusto-conical internal surface of the bore of the body of the coupling near the entrance to the corresponding annular convergent space around the pipe, the entrance to the said space being, of course, at the position at which the frusto-conical surface defining the space is of greatest diameter.

The rim portion of the sealing ring is furnished with an annular externally frusto-conical shaped flange which extends tangentially from the outer surface of the rim and converges inwardly from the entrance of the said annular frusto-conical space towards the narrower end thereof, such flange bearing circumferentially externally against the internal frusto-conical surface of the body of the coupling. The annular edge of the said flange remote from the said rim is inturned towards the axis of the coupling so as to bear upon the external surface of the pipe on which the coupling is placed, this inwardly directed part of the sealing ring being spaced from the said rim and the portion of the sealing ring between this inturned part of the flange and the said rim being well spaced from the surface of the pipe when first applied to the latter.

From the above description it will be appreciated that any radial section of the sealing ring will be substantially of chemical laboratory retort shape, the outlet stem of the retort having a slightly inturned end portion.

The said frusto-conical flange on the sealing ring is of such a length in the direction of the axis of the coupling as to provide the sealing ring with a very firm seating against the internal frusto-conical surface of the body of the coupling but its length is still only such as to leave ample room for the sealing ring to be moved bodily endwise into said annular space when the union nut is screwed tightly on to the body of the coupling.

Between the ring-like rim of the sealing ring and the inwardly directed end flange of the corresponding union nut is arranged a pressure or packing ring which is a free fit upon the pipe to which the coupling is to be applied and which has an outer end surface at right angles to the axis of the coupling so as to bear firmly against the inner surface of the inwardly directed flange of the union nut and has an inner end surface which has an inner surface of wide angled conical form

which converges inwardly towards its outer end. Preferably this conical surface of the pressure ring is at right angles in any radial section to the frusto-conical internal surface of the body of the coupling: thus, if the latter surface is at 15° to the axis of the coupling as it preferably will be, then the internal end surface of the pressure ring will make an angle of 15° with the outer surface of this ring.

It will be appreciated that a coupling as above described is assembled by first threading the union nut onto the end of the pipe, then placing the pressure ring onto the pipe inside the union nut with the plane surface of this ring in engagement with the corresponding internal surface of the end flange of the union nut; by then placing the sealing ring on the end of the pipe with the ring-like rim portion of the sealing ring in engagement with the conical inner end surface of the pressure ring and by then fitting the body of the coupling onto the end of the pipe so that the inwardly directed internal central annular flange thereof abuts the end of the pipe and the sealing ring is located within the frusto-conical bore of the said body; and by finally screwing the union nut on to the adjacent end of the body of the coupling so as to cause the pressure ring to bear upon the adjacent surface of the ring-like rim of the pressure ring and to urge the sealing ring axially inwardly along the convergent annular space defined by the external surface of the pipe and the internal frusto-nut onto the adjacent end of the body of the coupling, thereby compressing the sealing ring about the pipe. Continued screwing of the union nut onto the body of the coupling is then believed to cause the pressure ring and the frusto-conical surface of the said body to cause the ring-like rim of the sealing ring to be urged further inwardly and slightly inwardly and annularly to deform the pipe

so that the said rim is, as it were, extruded into the sealing position.

It will be appreciated that the second pipe is assembled very similarly to that already described, the union nut, pressure ring and sealing ring being mounted on the end of the pipe and then the latter inserted into the body of the union at the opposite end to the first-named pipe, whereupon the union nut is screwed onto its end of the body of the coupling and tightened up.

It will be appreciated that in using this invention in a pipe end fitting for blanking off a pipe, the body of the coupling above described will be replaced by a member representing approximately one-half of this body which is closed at its outer end so as to blank off the pipe to which the assembly is attached, appropriate means, e.g. flats, being provided on the union nut and the body of the coupling to hold the body against rotation with respect to the pipe, whilst the union nut is being tightened up, or unscrewed.

An important feature possessed by a coupling as above described is that the sealing ring does not bite along a circumferential line into the pipe to which it is fitted but bears upon the latter over a substantial annular area so that razor edge stresses are not set up which is, of course, a tremendous advantage in aircraft engine installations or indeed in any installation where continual high frequency vibration is experienced.

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#### PROVISIONAL SPECIFICATION.

No. 25999, A.D. 1956

#### Improvements in or relating to Pipe Couplings.

We, K.A.C. LIMITED, a British Company, of Fifth Street, Montrose Avenue, Hillington, Glasgow, S.W.2, Scotland, do hereby declare this invention to be described in the following statement:—

This invention concerns improvements in or relating to pipe couplings and whilst it is primarily concerned with couplings for connecting pipes together end to end, it may be used for securing a closure or blanking-off cap on the end of a pipe; for connecting a pipe to a draw-off cock, or to any other fitting but subsequently all these further

fittings will be regarded as, and referred to as, "pipes" unless otherwise specifically stated.

The invention is particularly concerned with couplings for use in conjunction with pipes of relatively small diameter (such as under two inches) and of relatively light gauge material and particularly of metals such as copper, aluminium or the like: such pipes are used especially in aircraft engine installations and often call for pipe couplings capable of withstanding high pressure and it is an object of this invention to provide a simple and improved form of coupling which



will afford a leak-tight joint with the pipe or pipes with which it is used.

According to this invention there is provided a pipe coupling which comprises a tubular body having an internal conical inwardly converging frusto-conical bore adapted to receive coaxially the end portion of a pipe, the said bore being so dimensioned with relation to said pipe as to provide around the latter an annular inwardly convergent annular space; a sealing ring adapted to be located in said annular space; and a union member adapted to surround the pipe end and so associated with the said body as to be capable of being drawn towards the latter to force the said sealing ring into said annular space, the said sealing ring having an external surface so shaped as to seat against the frusto-conical internal surface of the bore of the said body and also having an internal ring-like rim so formed and positioned as to bear circumferentially on the external surface of the pipe and to be contracted tightly onto the latter as the ring is forced into said convergent annular space.

According to a further feature of the invention the said sealing ring is made of a soft and ductile or substantially ductile metal, such as, for example, aluminium, so that it can be deformed inwardly by the inward pressure exerted thereon as it is pressed into the said convergent annular space around the pipe.

The sealing ring may be formed in any suitable way and may be formed as a casting or as a pressing, the ring-like rim being hollow or solid as desired.

Thus, in one form, the said sealing ring may be formed from a piece of cylindrical tubing which is first spun out to frusto-conical form and then has the marginal portion at the end of larger diameter curled inwardly over on itself to form the said ring-like rim, the marginal portion at the end of smaller diameter being conveniently turned inwardly so as to form at such end, an inwardly directed part substantially perpendicular to the axis of the sealing ring.

In another form, the sealing ring may be cast to approximately chemical laboratory retort shape in radial cross-section at any point in its circumference, this said cross-section thus having a relatively large circular end portion from the outer portion of which a stem part extends substantially tangentially and then turns slightly inwardly at its other extremity.

It will be appreciated that these two forms are similar except that, in the first form, the ring-like rim is hollow, whilst, in the second form, the ring-like rim is solid. In the case where the said rim is hollow, a greater flattening of such rim will occur when the sealing ring is forced into said convergent annular space and the area of contact

between the rim and the external surface of the pipe will be greater and a consequently tighter seal will be achieved.

Said body may have means for engagement with the end of a pipe or with the ends of adjacent end to end pipes so as to prevent axial movement of the body relatively to the pipe as the sealing ring is being forced into the said annular convergent space and said union member may be in the form of a nut adapted to be placed loosely around the pipe and to screw externally onto the said body, the arrangement being such that, as the union nut is screwed onto the body, the said sealing ring is forced coaxially into the frusto-conical bore of the latter.

Preferably a pressure ring is provided within the coupling between the said union member and the adjacent end of the sealing ring to transfer pressure from the union member to the ring and preferably the inner end surface of the pressure ring which engages the sealing ring is so inclined to the axis of the coupling as to exert, when pressed against the adjacent end of the sealing ring, an inward and contracting thrust upon the latter.

Thus the invention also resides in a method of applying an end fitting or coupling to a pipe in a fluid-tight manner which comprises arranging around the pipe an inexpandible convergent annular surface and driving between said surface and the pipe an internally annularly rimmed sealing ring in such a way as to contract the said sealing ring about the pipe and to cause the said rim to seat firmly on and even circumferentially to deform the pipe inwardly to receive such rim.

In order that the invention may be readily understood and that further features of same may easily be appreciated, one embodiment of the invention will now be described by way of example.

In the embodiment to be described the coupling is designed for connecting two straight pipes of identical external diameter together in end to end coaxial relationship, but it should be understood that the same construction can, with slight modifications, be applied to other forms of coupling such as elbow form couplings for connecting pipes together in any appropriate angular relationship, blanking off units for closing the end of a pipe, and so on.

The coupling now to be described comprises a tubular body which is externally cylindrical and has a central circumferential groove or channel up to which both ends of the tubular body is externally screw threaded so that the body may receive on each end thereof an internally correspondingly screw threaded union nut furnished at its outer end with an inwardly directed flange perpendicular to the axis of the coupling and

having a central hole closely to receive the pipe upon which the corresponding end of the coupling body is to be fitted.

Internally the tubular body of the coupling is provided centrally of its length with an annular inwardly directed flange adapted to form a shoulder or stop against which the ends of a pair of pipes inserted into the body of the coupling from opposite ends thereof may firmly engage, the internal diameter of the said flange being preferably the same as the internal diameter of the pipes.

The bore of the body of the coupling is enlarged on each side of the said central internal flange of the body and this enlargement is of inwardly convergent frusto-conical form in both cases so as to define around the pipes upon which the body of the coupling is used inwardly convergent annular spaces for receiving sealing rings, there being one sealing ring in each of said annular spaces.

The said sealing rings are formed of a soft metal such as, for example, aluminium, and each comprises an outer end portion in the form of a circular ring-like rim, this rim portion being of an internal diameter such as initially to be a close but free sliding fit onto the exterior of the pipe on which it is to be used, and of an external diameter such as to bear against the frusto-conical internal surface of the bore of the body of the coupling near the entrance to the corresponding annular convergent space around the pipe, the entrance to the said space being, of course, at the position at which the frusto-conical surface defining the space is of greatest diameter.

The rim portion of the sealing ring is furnished with an annular externally frusto-conical shaped flange which extends tangentially from the outer surface of the rim and converges inwardly from the entrance of the said annular frusto-conical space towards the narrower end thereof, such flange bearing circumferentially externally against the internal frusto-conical surface of the body of the coupling. The annular edge of the said flange remote from the said rim is intumed towards the axis of the coupling so as to bear upon the external surface of the pipe on which the coupling is placed, this inwardly directed part of the sealing ring being spaced from the said rim and the portion of the sealing ring between this intumed part of the flange and the said rim being well spaced from the surface of the pipe when first applied to the latter.

From the above description it will be appreciated that any radial section of the sealing ring will be substantially of chemical laboratory retort shape, the outlet stem of the retort having a slightly intumed end portion.

The sealing rings may be formed in any

suitable way and may be formed as castings or as pressings, the ring-like rim portion being hollow or solid as desired.

Thus, in one form, each sealing ring may be formed from a piece of cylindrical tubing which is first spun out to frusto-conical form and then has the marginal portion at the end of larger diameter curled inwardly over on itself to form the said ring-like rim, the marginal portion at the end of smaller diameter being conveniently turned inwardly substantially perpendicularly to the axis of the sealing ring so as to form, at such end, the said inwardly directed part.

In another form, the sealing ring may be cast to the said chemical laboratory retort shape.

In the first form the said ring-like rim portion will be hollow, whilst in the second form the said rim portion will be solid.

The said frusto-conical flange on the sealing ring is of such a length in the direction of the axis of the coupling as to provide the sealing ring with a very firm seating against the internal frusto-conical surface of the body of the coupling but its length is still only such as to leave ample room for the sealing ring to be moved bodily endwise into said annular space when the union nut is screwed tightly on to the body of the coupling.

Between the ring-like rim of the sealing ring and the inwardly directed end flange of the corresponding union nut is arranged a pressure or packing ring which is a free fit upon the pipe to which the coupling is to be applied and which has an outer end surface at right angles to the axis of the coupling so as to bear firmly against the inner surface of the inwardly directed flange of the union nut and has an inner end surface which has an inner surface of wide angled conical form which converges inwardly towards its outer end. Preferably this conical surface of the pressure ring is at right angles in any radial section to the frusto-conical internal surface of the body of the coupling: thus, if the latter surface is at  $15^\circ$  to the axis of the coupling as it preferably will be, then the internal end surface of the pressure ring will make an angle of  $15^\circ$  with the outer surface of this ring.

It will be appreciated that a coupling as above described is assembled by first threading the union nut on to the end of the pipe, then placing the pressure ring onto the pipe inside the union nut with the plane surface of this ring in engagement with the corresponding internal surface of the end flange of the union nut; by then placing the sealing ring on the end of the pipe with the ring-like rim portion of the sealing ring in engagement with the conical inner end surface of the pressure ring and by then fitting the body of the coupling onto the end of

the pipe so that the inwardly directed internal central annular flange thereof abuts the end of the pipe and the sealing ring is located within the frusto-conical bore of the said body; and by finally screwing the union nut onto the adjacent end of the body of the coupling so as to cause the pressure ring to bear upon the adjacent surface of the ring-like rim of the pressure ring and to urge the sealing ring axially inwardly along the convergent annular space defined by the external surface of the pipe and the internal frusto-conical surface of the bore of the body of the coupling, thereby compressing the sealing ring about the pipe. Continued screwing of the union nut onto the body of the coupling is then believed to cause the pressure ring and the frusto-conical surface of the said body to cause the ring-like rim of the sealing ring to be urged further inwardly and slightly inwardly and annularly to deform the pipe so that the said rim is, as it were, extruded into the sealing position.

The second pipe is assembled very similarly to that already described, the union nut, pressure ring and sealing ring being mounted on the end of the pipe and then the latter inserted into the body of the union at the opposite end to the first-named pipe, whereupon the union nut is screwed onto its end of the body of the coupling and tightened up.

It will be appreciated that in using this invention in a pipe end fitting for blanking off a pipe, the body of the coupling above described will be replaced by a member representing approximately one-half of this

body which is closed at its outer end so as to blank off the pipe to which the assembly is attached, appropriate means, e.g. flats, being provided on the union nut and the body of the coupling to hold the body against rotation with respect to the pipe, whilst the union nut is being tightened up, or unscrewed.

An important feature possessed by a coupling as above described is that the sealing ring does not bite along a circumferential line into the pipe to which it is fitted but bears upon the latter over a substantial annular area so that razor edge stresses are not set up which is, of course, a tremendous advantage in aircraft engine installations or indeed in any installation where continual high frequency vibration is experienced.

In the case where the ring-like rim portion of the sealing ring is hollow, a greater flattening of such rim will occur when the sealing ring is forced into the convergent annular space around the pipe and the area of contact between the said rim and the external surface of the pipe will be greater and a consequently tighter seal will be achieved.

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Fig. 1.

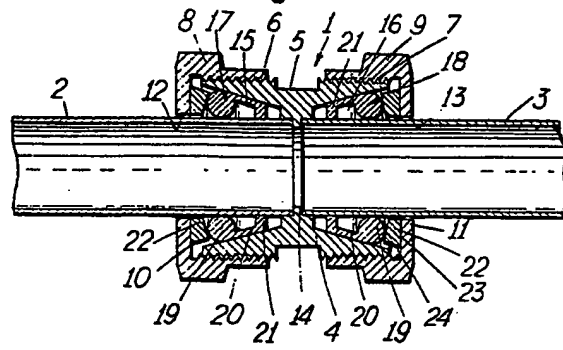


Fig. 2.

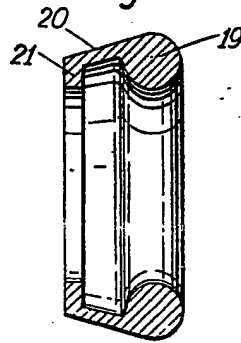


Fig. 3.

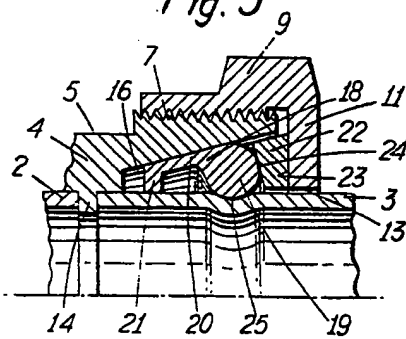


Fig. 4.

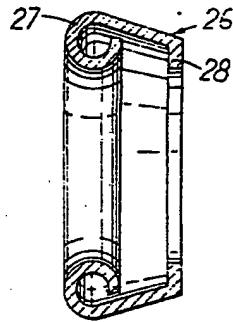


Fig. 5.

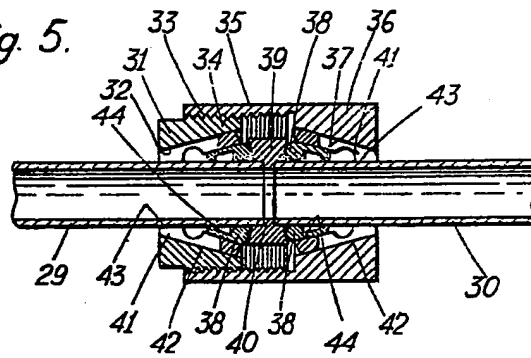


Fig. 6.

